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Post-traumatic bifid condyle: the pathogenesis analysis

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Abstract – This study investigated the characteristic of bifid condyle secondary to temporomandibular joint (TMJ) trauma, aiming to analyse the pathogenesis of post-traumatic bifid condyle. Four cases identified as having bifid condyle secondary to TMJ trauma were involved in this study. The relative information extracted from the case records included patients' complaint, history of injury and radiographic appearance, which were used to analyse the characteristic and pathogenesis of post-traumatic bifid condyle. The results indicated that there was a correlation between condylar trauma degree and bifid condylar head appearance after trauma. For severe condylar fracture, it might result in Y-shaped condyle associated with TMJ ankylosis; and condylar groove could be associated with the slight trauma in condyle articulating surface. In conclusion, as a specific entity, post-traumatic bifid condyle may develop in cases with insufficient remodelling capacity after condyle trauma, and it seems that the severity degree of trauma, the site of trauma and its relation to the insertion of the lateral pterygoid muscles are factors associated with the appearance and orientation of bifid condyle.

The bifid condyle is a rather uncommon condition that is diagnosed radiographically. The aetiology of bifid condyle remains uncertain, and developmental abnormality, traumas, nutritional disorders, infection, irradiation, genetic factors, teratogenic embryopathy and surgical condylectomy may all be causative factors (1–3). There is little information about the real incidence of this malformation because of the lack of epidemiological data. According to the reviewed literature, facial trauma in early stages of facial development is the most important aetiologic factor of this pathology (4–7). According to the current English literature, history of condylar trauma is evident in approximately 25% of all bifid condyle cases reported. The present study investigated the characteristic of bifid condyle secondary to temporomandibular joint (TMJ) trauma, aiming to analyse the pathogenesis of post-traumatic bifid condyle.

Patients and methods

Four cases identified as having bifid condyle secondary to TMJ trauma were involved in this study. The relative information extracted from the case records included patients' complaint, history of injury and radiographic appearance, which were used to analyse the characteristic and pathogenesis of post-traumatic bifid condyle.

Results

Of the four patients, one was man, and ages ranged between 18 and 25 years (Table 1). The patients' complaint included malocclusion, mandibular asymmetry and limiting mouth opening, and one patient had no any complaint. All patients had a history of facial trauma in childhood (Table 1).

The radiographic appearance of post-traumatic bifid condyle was widely variable with some features, and the condyles showed a shallow groove to two distinct condylar heads. It seemed that there was a correlation between condylar trauma degree and bifid condylar head appearance after trauma. For the severe condylar fracture, it might result in the typical Y-shaped condyle associated with TMJ ankylosis (such as case 4); and condylar groove could be associated with the slight trauma in condyle articulating surface (such as case 1).

Discussion

The number of reported bifid condyle cases increased in recent years, as the use of dental panoramic radiographs and especially CT examination became widespread. Facial trauma in early stages of development is the most important aetiologic factor of bifid condyle. Thomason & Yusuf (8) reported two cases related to trauma, which eventually led to bifid condyle formation after healing. Sales et al. (9) reported a case of a patient who developed bifid condyle 4 years after condylar fracture. The condition of bifid condyle is usually asymptomatic. However, some post-traumatic bifid condyle cases are found in patients with TMJ symptom or ankylosis (10, 11). Stadnicki (12) reported a case of a 3-year-old girl with limited mouth opening and a bifid condyle following forceps delivery, and the girl subsequently developed ankylosis at the age of 12 years. In the present study,

Table 1. Relative information of the four cases with post-traumatic bifid condyle

Case	Sex	Age	Complaint	History	Radiographic appearance
1	Male	18	No any symptom (casual finding in routine dental examination)	Injury on the chin at 10 years of age, slight pain in the left TMJ for several days	Left condyle showing a shallow groove in the anteroposterior direction (Fig. 1)
2	Female	24	No relative complaint (casual finding in routine dental examination)	Facial fractures (left parasymphyseal fracture and right upper alveolar fracture) 10 years ago, mild pain in the right TMJ for several weeks	Slim right condyle with a groove in the anteroposterior direction (Fig. 2)
3	Female	22	Mandibular asymmetry	Injury on the chin at 8 years of age, intermittent pain in left TMJ for several months	Mandible slightly deviated to the left side, and alteration in the left condyle with formation of a mediolateral bifid condyle (Fig. 3)
4	Female	25	Inability to open mouth	Injury on the chin at 13 years of age, sustained painful swelling of the left preauricular regions for several months, mouth opening progressively getting less	Mass of bone obliterating the TMJ space on two sides, but well-defined Y-shaped condyle lying in mediolateral relationship on the left side (Fig. 4)

TMJ, temporomandibular joint.

Fig. 1. In case 1, the left condyle is normal in the panoramic radiograph, but CT scan shows a shallow groove in the anteroposterior direction.

Fig. 2. In case 2, panoramic radiograph shows the right condyle is slim, and there is a groove in the anteroposterior direction (CT scan).

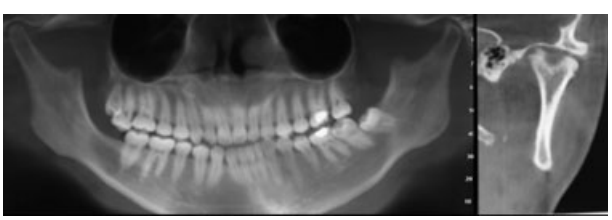

Fig. 3. In case 3, the panoramic radiograph shows mandible deviated to the left side, and CT scan reveals the alteration in the left condyle with formation of a mediolateral bifid condyle.

based on the four patients' history and both the clinical and radiographic examinations, the diagnosis of post-traumatic bifid condyle was made. In these patients,

Fig. 4. In case 4, the panoramic radiograph shows mass of bone obliterating the TMJ space on two sides, but two well-defined Y-shaped condyles lying in mediolateral relationship on the left side (CT scan).

childhood TMJ trauma was responsible for the bifid condyle formation.

A trauma aetiology in bifid condyle cases has been supported by results of many reports. However, the real pathogenesis of post-traumatic bifid condyle is still unknown. Although the trauma and fractures of condylar region are common in clinic, post-traumatic bifid condyle formation is rare. It is believed that minor trauma to the condylar 'growth center' may result in condylar bifidism, which would then represent a developmental anomaly (1). It has also been reported that bifid condyle formation could result from healing and remodelling after trauma and fractures of condylar region and condylectomy during infancy and puberty (2, 8, 9, 13–18). We support the opinion that post-traumatic bifid condyle develops in cases with insufficient remodelling capacity. After condylar trauma or fracture resulting in the condyle dividing into two major parts, the major bony fragment and the condyle stump, sufficient healing and remodelling processes might produce the two parts unite together and form one new condyle. Otherwise, the insufficient remodelling of the condylar bony fragment might give rise to the bifid condylar formation.

However, we also deem that insufficient remodelling capacity is not the only contributing factor in the formation of post-traumatic bifid condyle. Based on the data from literatures, the radiographic appearance of

post-traumatic bifid condyle is widely variable with some features. The extent of bifid condyle may range from a shallow groove to discrete condylar heads with a separate neck. In our cases, the condyles also showed a shallow groove to two distinct condylar heads. It seemed that there was a correlation between severity degree of condylar trauma and bifid condylar head appearance after trauma. In our opinion, for the severe condylar fracture, it might result in the typical Y-shaped condyle associated with TMJ ankylosis; and condylar groove could be associated with the slight trauma in condyle articulating surface.

The orientation of bifid condyle was classified as anterior–posterior and mediolateral (6). It was believed that the mediolateral orientation of the bifid condylar heads supports the developmental origin theory, whereas an anteroposterior orientation supports traumatic origin (19–23). Yao et al. (24, 25), however, demonstrated experimentally that a fracture of the mandibular condyle could result in mediolateral as well as anteroposterior orientation of the mandibular condyles. Although the orientation of bifid condyles in our cases was mediolateral, we deem that anteroposterior orientation of the bifid condylar heads can also result from traumatic event. We tend to support the hypothesis that the site of fracture of the mandibular condyle and its relation to the insertion of the lateral pterygoid muscles are factors determining the future development of bifid condyle (11). When a fracture of the condylar neck occurs, the condyle is displaced anteromedially by the action of the lateral pterygoid muscle, and a new condylar head develops through metaplasia of local fibroblasts at the normal anatomical site, while the displaced head is undergoing resorption. In this instance, the anteroposterior bifid condylar heads might be formed during the healing period of condylar fracture. When sagittal fracture through the condylar head happens, the sagittal condylar dividing will engender heads medially and laterally. During the healing of sagittal fracture, the medial head might also displace anteromedially by the action of the lateral pterygoid muscle, but the action is smaller than that of condylar neck fracture.

In conclusion, as a specific entity, post-traumatic bifid condyle may develop in cases with insufficient remodelling capacity after condyle trauma, and it seems that the severity degree of trauma, the site of trauma and its relation to the insertion of the lateral pterygoid muscles are factors associated with the appearance and orientation of bifid condyle.

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